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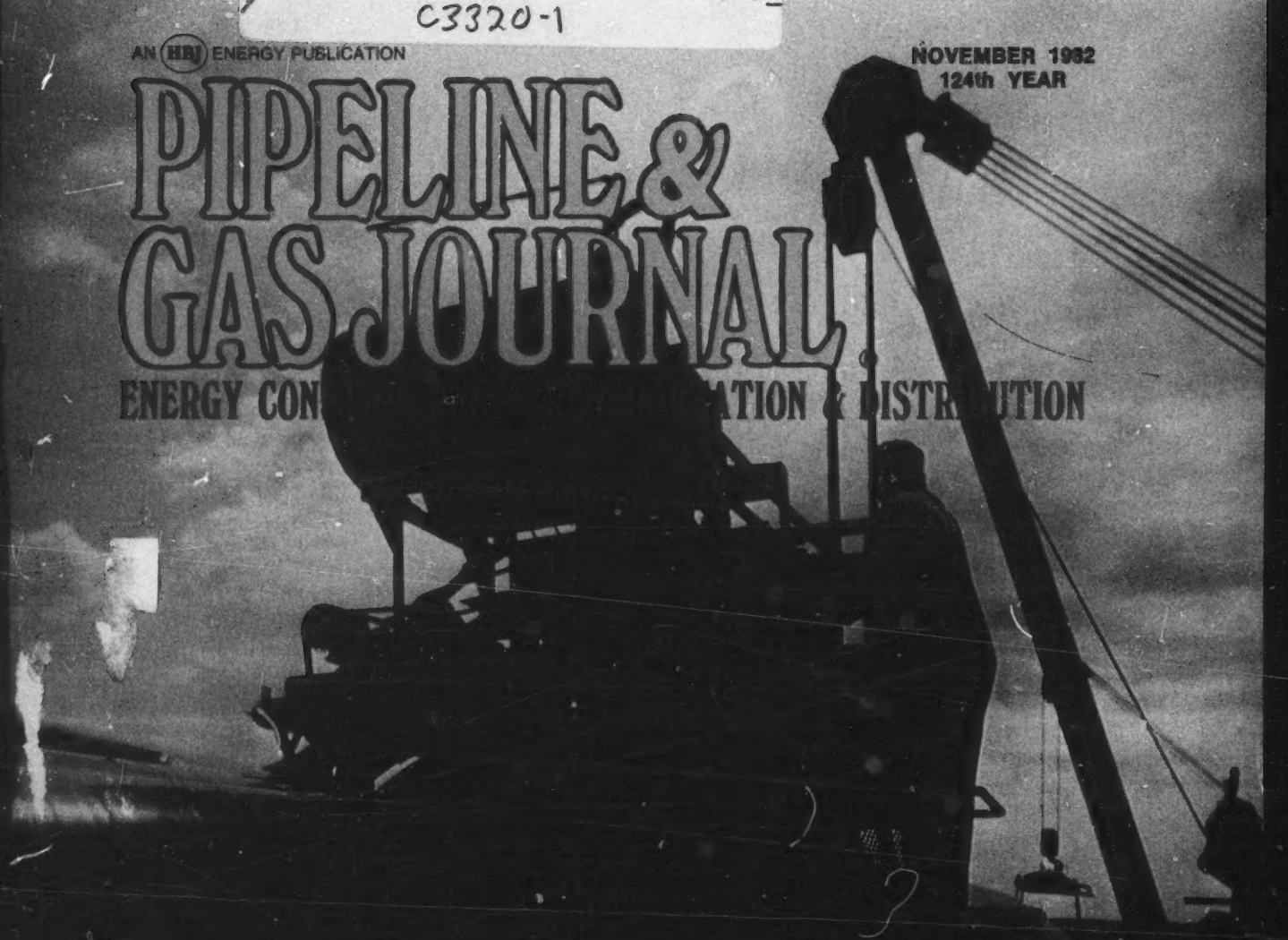

Northern Border Pipeline Report

Peakshaving Forecast Report

LNG Scorecard

PIPELINE & GAS JOURNAL

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Northern Border Pipeline In Operation ... 19
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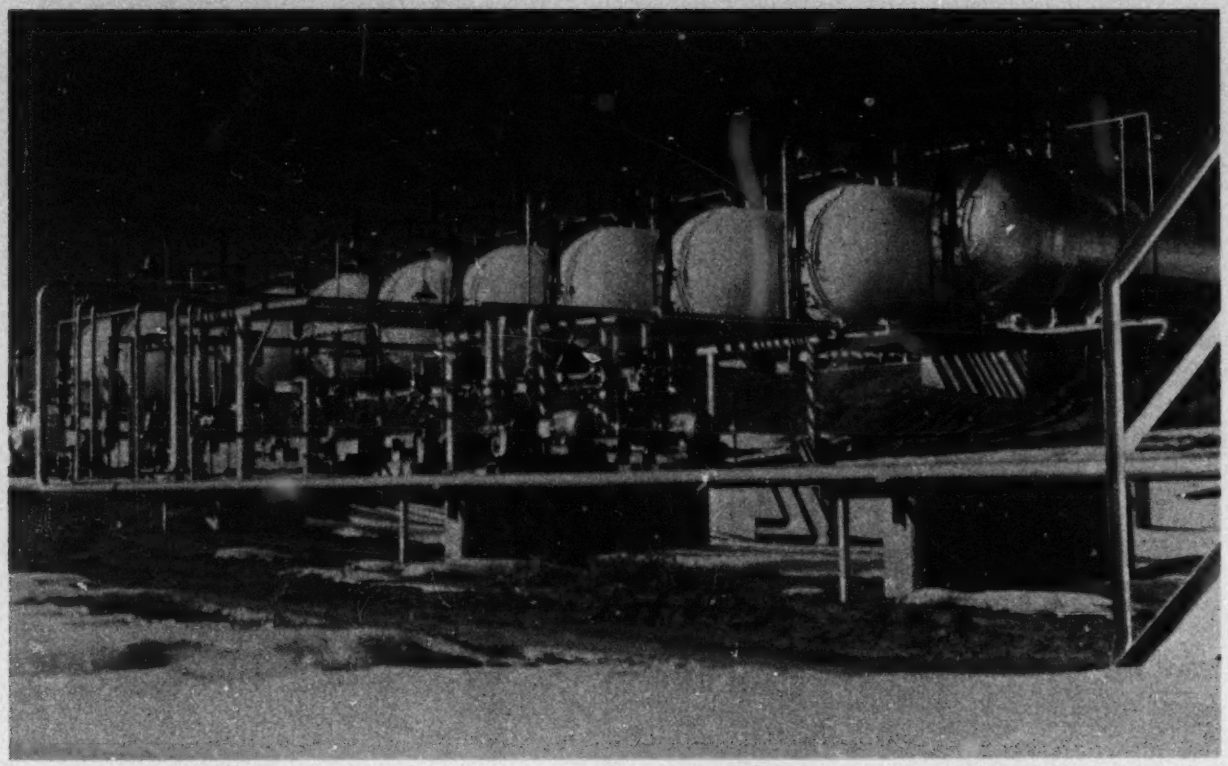
Short but essential 8-in. products pipeline connects Gulf Pipeline Co.'s Mesquite Products System to the Cleburne, Tex., facilities of the Santa Fe Railway, transporting diesel fuel for locomotives.

COVER
Taping gang at work on one of the final sections of the Northern Border Pipe Line during summer of 1982.
– photo courtesy Northern Plains Natural Gas Co.

Peakshaving Forecast and Report



Propane-air plant sendout gas provides only 7.14% of the total 73.54 Bcf maximum delivery capacity of the nation's gas industry peakshaving facilities, but for the companies who depend upon it to "shave" the very highest wintertime peak demands, it is an extremely valuable resource..

Peakshaving Capacity Reaches Record Total For 1982-83 Winter

by Dean Hale, *Editor*

The winter of 1982-83 is expected to prove interesting and frustrating to the U.S. natural gas industry at a time when it is faced with a temporary surplus of gas supply, increasing prices from producers and pipelines, customer resistance to higher gas rates, forecasts of a severe winter, and some startling changes in gas usage patterns, particularly in the industrial sector, that could affect peakshaving operations.

Even though total gas sales are down slightly for 1982 (through September), there are still some 40 million gas customers who heat their homes with natural gas, and as consumption history has shown in the past several years, those customers abandon their conservation efforts when it really gets cold and put heavy demands on the gas distribution utilities (and pipelines) to provide them sufficient gas supplies when blizzards, blue northers, and extended cold spells occur.

For the gas utilities, that may well mean another record year in peakshaving deliveries as both contract and supplemental sources of gas supply are utilized to insure continued cold weather service.

PIPELINE & GAS JOURNAL's latest annual peakshaving survey indicates that a capacity of 73.54 billion cu ft maximum delivery for one 24-hr period, using gas from all available peakshaving gas sources, could be available if needed. To that can be added an estimated 68.4 Bcf of regularly scheduled deliveries per day to produce a projected maximum delivery in one day that *could* reach 141.94 Bcf. It's highly unlikely that such a figure will be obtained simply because the entire nation seldom experiences a major, nationwide cold spell in all of the 48 contiguous states simultaneously.

For the 1982-83 winter, a top delivery of 78 to 87 Bcf in a single 24-hr period is projected for the industry. Supplemental gas supplies from propane-air plants, LNG peakshaving plants, and underground storage, as well as other sources such as line pack, SNG plants, gas holders, etc., are expected to provide a substantial portion of the gas demand at any one time during the winter season in areas such as the north central and northeastern states where cold weather often prevails for extended periods.

For the 1982-83 winter season, peakshaving supplies will include:

58.94 Bcf from underground gas storage
5.25 Bcf from propane-air plants
9.10 Bcf from LNG peakshaving and satellite plants
0.25 Bcf from other sources

The increase in deliverability for the 1982-83 winter season is a small 670 MMcfd, the least amount in 15 years that PIPELINE & GAS JOURNAL has been examining, surveying, and forecasting the gas industry peakshaving requirements. Underground gas storage customarily accounts for a significant amount of the yearly increase; there was a large increase in storage capacity during the year, from the addition of major new facilities, but much of it was offset by the abandon-

U.S. Underground Gas Storage Operations — Operating Companies — 1980 Data

Company		No. of Fields	No. of Wells	Miles Storage Lines	Storage Compressor Stations No.	Storage Compressor Stations HP.
ANR Storage Co.		4	40	21.80	3	26,250
Arkansas Louisiana Gas Co.		5	73	39.00	5	42,200
Arkansas Oklahoma Gas Corp.		1	12	3.00	1	370
Arkansas Western Gas Co.		4	12	3.72	4	2,355
Battle Creek Gas Co.		3	3	2.00	2	1,050
		— (1 under development) —				
Bear Creek Storage Co.		1	52	25.5	1	28,000
Brady, Tex., Municipal Gas Corp.		1	2	2.00	1	420
Cabot Corp.		2	13	14.60	2	2,395
Central Illinois Light Co.		2	81	21.27	2	4,000
Central Illinois Public Service		3	78	9.80	3	3,220
		— (1 under development) —				
Cities Service Gas Co.		10	589	164.00	6	29,800
Citizens Gas & Coke Utility		8	182	319.00	2	3,695
Colorado Interstate Gas Co.		4	122	230.00	3	9,700
Columbia Gas Transmission Corp.		49	3,725	1,221.50	27	108,925
Columbia Gas of Pennsylvania		1	8	3.43	1	900
Consolidated Gas Supply	Owned	9	1,054	458.00	9	119,300
	Joint	4	296	117.00	8	60,390
		13	1,349	575.00	17	179,690
Consumers Power Co.		11	477	128.66	4	78,810
Delhi Gas Pipeline Corp.		1	— (under development) —			
East Ohio Gas Co.		4	757	257.90	3	20,220
El Paso Natural Gas Co.		2	35	39.00	1	4,400
		— (1 under development) —				
Egyptian Gas Storage Co.		2	3	—	—	—
Equitable Gas Co.		15	280	128.33	8	15,340
Felmont Oil Corp.		1	10	6.00	1	1,050
Gas Utilities (Ill.)		1	4	3.10	—	—
Hampshire Gas Co.		1	13	17.00	1	1,640
Honeoye Storage Corp.		1	34	15.80	1	2,200
Hoosier Gas Corp.		3	24	8.30	0	—
Houston Pipe Line Co.		1	59	12.00	4	23,010
Illinois Power Co.		8	236	34.75	8	12,100
Indiana Gas Co.		7	273	104.81	4	2,770
Kane Gas Light & Heat Co.		1	14	10.00	1	60
Kansas Nebraska Natural Gas		4	34	23.40	3	5,530
Laclede Gas Co.		1	50	32.08	1	9,020
Lawrenceburg Gas Co.		1	1	—	—	—
Lone Star Gas Co.		11	109	78.04	9	24,770
Louisville Gas & Electric Co.		9	837	126.16	3	19,055
Michigan Consolidated Gas Co.		5	514	90.00	4	71,000
Michigan Gas Storage		3	554	166.10	1	30,900
Michigan Gas Utilities Co.		3	8	3.75	2	1,500
Michigan Wisconsin Pipe Line Co.		15	1,254	316.00	10	110,700
		— (1 under development) —				
Midwestern Gas Transmission Co.		3	55	11.70	2	1,593
Minnesota Gas Co.		2	40	15.00	1	2,200
Mississippi River Transmission Corp.		3	66	72.06	3	22,050
Mississippi Valley Gas Co.		1	3	1.00	1	584
Montana-Dakota Utilities Co.		3	87	103.00	3	22,122
Montana Power Co.		4	39	38.00	3	5,960
Mountain Fuel Resources, Inc.		1	44	21.76	1	13,000
Mountain Fuel Supply Co.		3	26	10.00	3	6,000
Mustang Fuel Corp.		1	1	4.00	—	—
National Fuel Gas Supply Corp.	owned	26	909	486.80	15	25,825
	joint	4	379	63.10	(4)	(39,900)
	Total	30	1,288	549.90	15	25,825
		— (3 under development) —				
National Gas & Oil Corp.		3	31	8.00	3	1,950
National Zinc Co.		1	7	—	1	119
Natural Gas Pipeline Co. of America		13	850	305.00	8	119,040
North Penn Gas Co.	owned	2	18	12.66	1	4,995
	(joint	1)				
Northern Gas Co.		4	8	12.00	4	2,183
Northern Illinois Gas Co.		7	505	264.03	6	113,990
Northern Indiana Public Service		2	135	29.00	2	7,320
Northern Natural Gas Co.		3	306	185.80	2	21,160
Oklahoma Natural Gas Co.		4	60	22.00	2	11,200
Pacific Gas & Electric Co.		3	94	22.47	3	14,990
Panhandle Eastern Pipe Line Co.		5	241	114.00	5	19,350
Peoples Gas Light & Coke Co., The		1	138	189.50	1	14,900
Peoples Natural Gas Co.		8	74	37.00	7	12,520
T.W. Phillips Gas & Oil Co.		7	74	—	7	1,995
Phillips Petroleum Co.		3	6	22.00	2	620
Pioneer Natural Gas Co.		2	1	1.00	1	880
		— (1 under development) —				
Public Service Co. of Colorado		1	13	8.27	1	17,000
South Louisiana Production Co.		1	3	10.00	1	30
Southeastern Michigan Gas Co.		3	8	2.00	3	3,920
Southern Indiana Gas & Electric Co.		2	83	17.30	2	1,500
Southern Natural Gas Co.		1	72	48.22	1	21,750
Southern California Gas Co. & Pacific Lighting Gas Supply Co.		6	325	124.28	6	104,090
		— (1 under development) —				
Southern Union Co. (Gas Co. of New Mex.)		1	12	12.00	1	3,000
Southwest Gas Corp.		1	— (1 under development) —			
Southwest Gas Storage Co.		1	49	18.00	1	6,000
Southwestern Gas Pipeline, Inc.		2	11	3.45	1	440
Tennessee Gas Pipeline Co.	(joint)	5	406	2.00	2	19,600
Texas Eastern Transmission Corp.	owned	1	75	13.20	1	11,000
Texas Gas Transmission Corp.		10	457	217.26	11	19,765
Transcontinental Gas Pipe Line Corp.	owned	3	57	22.45	3	46,100
	(joint	2	181	79.00	1	34,300)
Trunkline Gas Co.		1	86	27.00	1	15,400
Union Gas System, Inc.		4	94	19.80	1	165
United Gas Pipe Line Co.	owned	1	19	6.10	1	2,550
	joint	1	73	21.70	1	34,000
	Total	2	92	27.80	2	36,550
Valero Gas Storage Co.		1	2	n.a.	1	8,000
		— (under development) —				
Victor Gas Co		1	6	12.00	2	300
Washington Natural Gas Co. Washington Water Power Co. Northwest Pipeline Corp.	joint	1	77	9.90	1	12,500
Western Kentucky Gas Co.		6	60	203.04	4	1,555
Western Slope Gas Co.		3	37	27.34	2	3,368

ment of older facilities that became uneconomical to maintain and operate. Deliverability from LNG peakshaving increased very slightly with the beginning operation of one major new facility. Propane-air plant additions, significant in several previous years, continued to decline with only one plant reported as new and some smaller additions to existing plants and to propane storage capacity. The remaining "other" sources also declined slightly – sendout from SNG plants operated to make peakshaving gas supplies is very costly because the feedstocks (naphtha and other hydrocarbons) remain very expensive and such plants operate only if absolutely necessary. Other sources also include the line pack, gas holders, some buried bottle-type storage, and enrichment of gas stream by direct injection of propane or ethane to boost the Btu content of the gas stream.

Underground Gas Storage

Gas distribution companies and gas pipelines continue their search for new underground gas storage containers – abandoned oil and gas fields, aquifers, salt domes, and tight

caverns with an eye to the future. With emphasis on more efficient utilization of gas energy and on conservation, industry planners have noted that nearly every Mcf of new sales will require a certain amount of peakshaving capacity – ranging from 0.3 to 0.8 Mcf for every Mcf unit of demand. Each company's need is different – but all of them report a need.

During 1982, the gas industry spent more than $248 million for new underground gas storage facilities (compared to $314 million in 1981) and early projections for 1983 indicate that over $227 million will be spent for storage facilities – drilling and completing injection and withdrawal wells, observation wells, installing field lines, and installing compressor horsepower and related measurement, dehydrating, filtering, and odorization equipment and control systems and communications systems.

As of Nov. 1, 1982, there were 399 gas storage fields being operated or developed by 91 companies, including 387 fields considered active, another 12 under development or planned. Maximum deliverability of the 387 fields is estimated at 58.939 Bcf per day in a 24-hr period.

At the 399 operating and under-development gas storage fields, there are 18,314 wells (a net increase of 249 over 1981); 7191 miles of field lines (up 371 over 1981's total), and a net gain of two compressor stations with a net increase of 12,330 hp for the year.

Preliminary data for 1983 indicates that some 170 new wells will be drilled, over 380 will be worked over, 120 miles of field lines planned, and over 20,000 hp to be added. These projections do not include requirements of projects not yet announced.

Current gas storage developments include:

Pacific Lighting Corp. and Pacific Gas & Electric Co. have abandoned development of the Ten Section field southwest of Bakersfield, Calif., as an underground gas storage field that would have provided a deliverability capacity of over 1 billion cu ft per day for winter peak demand. PLC and PG&E cited inflation as the reason for discontinuing the project. Original estimate of $142 million (1980 dollars) had increased to $357 million in 1983-84 dollars. Changes in design also increased costs.

Battle Creek Gas Co. has added a new field – the Harris Field in Calhoun County, Mich. – for 1982 and plans to add another – Watson-Odell Field in Calhoun County – during 1983.

Michigan Gas Utilities has added three new fields to its gas storage operations.

Northern Natural Gas Co. plans to develop one new field in 1983 and expand its Redfield (Iowa) storage operations at a total cost of $10 million. Program will add 5 Bcf to NNG's capacity.

Union Light Heat & Power Co. is abandoning its storage field activities.

Valero Gas Storage is developing two new salt dome caverns that will provide up to 5 Bcf capacity.

Propane-Air Plants

Propane-air changes were insignificant during 1982. Only one new plant was added to bring the total 504 propane-air plants operated by 242 gas utilities in 41 states. Deliverability increased slightly to 5.25 Bcf per day total, and an estimated 8.5 billion gal. of additional propane storage was added at both new and existing propane-air plants during 1982.

LNG Peakshaving Developments

Southwest Gas Corp.'s H. G. Laub peakshaving plant at Dayton, Nev., is to begin operation in November. Startup of the facility, built under a turnkey contract by CBI, is scheduled for September. An interesting aspect of the project is its innovative financing arrangement. In August, FERC authorized a sale/lease-back arrangement.

A construction trust has been arranged whereby Southwest will lease the facilities for a period of 20 years at a fixed annual rental. Arrangement includes a renewal option for five years at a reduced rental and subsequent renewal options at fair rental value. Southwest also has option to purchase the LNG plant and related pipeline loop at end of the lease or its renewals at a then-current fair market value.

The lease will be a tax deductible operating expense, and will not be capitalized or included in rate base. FERC said this should result in reduced revenue requirements.

North Carolina Natural Gas Corp. has announced plans to construct a peakshaving LNG plant in Johnston County, N.C. The plant is to have a liquefaction capacity of 3.5 MMcf per day (net) and will incorporate a mixed-refrigerant cycle. Storage capacity will be 212,000 bbl in an aboveground 9% nickel-steel tank. The type of vaporizer to be used has not been selected, but it will have a capacity of 60 MMcfd at a nominal sendout pressure of 500 psi and a peak rating of 650 psi. Construction will begin after regulatory approvals have been obtained. The facility is scheduled to go on-stream in 1984. North Carolina Natural Gas Corp., an investor-owned utility headquartered in Fayetteville, N.C., has 83,000 customers in 22 communities. Largest of these is Fayetteville. Gas sales are approximately 40 Bcf annually.

Energy Terminal Services (ETS) continues to process its application to convert the Staten Island Terminal site into a peakshaving facility. The pace at which progress is being made toward resolving the on-going regulatory approvals is snail-like. ETS' considerable efforts have resulted in some progress in proceedings involving FERC and with respect to Section 7 approvals under the Natural Gas Act, DOT's Materials Transportation Bureau (MTB) with regard to compliance with applicable provisions of Federal Safety Standards under 49CFR Part 193, and the U.S. District Court over jurisdictional matters.

On Jan. 1, 1982, the final provisions of MTB's Liquefied *Natural Gas Facilities; Federal Safety Standards* became effective. Implementation of these provisions had been delayed as they could have involved purchase and installation of new equipment or material. The provisions covered included those involving personnel safety, communications systems, fire and gas detection equipment, fire control equipment, security-related systems, and alternative power sources. The LNG industry has devoted a significant effort during the past two years since these standards were enacted to comply with them. The industry safety record has been outstanding to date and there is every indication that efforts are being sustained to keep it that way.

In Europe, activities are slow in the LNG peakshaving area. Principal activities in Europe center about the British Gas Corp., now constructing its sixth and seventh peakshaving facilities at the Isle of Grain and Dyenevor Arms. At Canvey Island, the cryogenic inground storage tanks used for peakshaving since the baseload import from Algeria terminated in mid-1981 have been abandoned. The four 300,000 bbl capacity pits have been filled in with sand. It is intended that the terminal facility will be maintained for peakshaving using its 10.3 MMcf per day liquefier to produce LNG from North Sea gas. The LNG would be stored in the 392,000 bbl capacity available in the six small, conventional tanks. A project has also been completed to use 3000 tons of LPG storage capacity at the facility to supply LPG-air for peakshaving in the regional transmission system.

When the 14 large-capacity LNG storage tanks are completed and operating at the peakshaving facilities throughout the United Kingdom, some 4 million bbl of capacity (1.4 billion cu ft of gas) will be available for peakshaving. From that time in 1983, it is unlikely that the number of sites would be increased for some time as additional peakshaving supplies will be available from salt cavity storage at Hornsea. In addition, seasonal supplies will be available from the Rough gas field, partially depleted but now to be used for storage, and from the new Morecambe Bay field. **P&GJ**

SCORECARD

U.S. and Canadian LNG Peakshaving Facilities

November 1982

Company and Plant Site	Liquefaction Plant Capacity, Mlbbl/d-day	Storage Capacity, Mbbl	Mlbbl	Total Design Capacity	Regasification — Mlbbl/d Runs	No. of Days	Type	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
APCI-HEGEA Hopkinton, Mass.	18.9	2000 (2 at 280)	560	248	4 at 62	8	Submrgd	Aboveground, 9% nickel	CBI	Cryo-Methane	Cascade	1967 — plant; 1971 on new tanks
APCI-HEGEA Hopkinton, Mass.	—	1050	290	—	—	—	—	Aboveground, 9% nickel	CBI	—	—	1975 — third tank
ALABAMA GAS CORP. Birmingham, Ala.	4.85	625	180	127/83	3 at 42.5	10	Submrgd	Aboveground, 9% nickel	CBI	Air Products & Chemicals, Inc.	Cascade	1965
ALABAMA GAS CORP. Birmingham, Ala.	—	625	180	42.5	1 at 42.5		Submrgd	Aboveground, aluminum	CBI	—	—	1971 — second tank
ALABAMA GAS CORP. Cossada, Ala.	2.7	800	175	80	1 at 40	15	Submrgd	Aboveground, aluminum	CBI	CBI	Modified Cascade	1972
ATLANTA GAS LIGHT CO. Riverdale, Ga.	10.0	1080	290	200	3 at 100	5	Uniflux	Aboveground, aluminum	CBI	Air Liquid.	TEAL Expander Process liquid	1972
ATLANTA GAS LIGHT CO. Riverdale, Ga.		1500	450	—	—	—	—	Aboveground, 9% nickel	CBI	—	—	1973
ARKANSAS-MISSOURI POWER CO. Ypsilanti, Ark.	0.96	374	110 (2 x 55)	66	2 at 33	6	Direct Fired	Aboveground, aluminum	Brown, Minneapolis Tank & Fab. Co.	Procrss Constructors, Inc.	Stirling	1973 — (1572 as satellite)
BALTIMORE GAS & ELEC. CO. Baltimore, Md.	2.75	560	145 (2 x 72.5)	187.5/125	3 at 62.5	5	Submrgd	Aboveground, aluminum	CBI	CBI	Expander	1971
BALTIMORE GAS & ELEC. CO. PLANT No. 2, Baltimore, Md.	2.4	500	145	62.5	1 at 62.5	8	Submrgd	Aboveground, aluminum	CBI	CBI	MRL	1973
BAY STATE GAS CO. Ludlow, Mass.	7.5	1000	290	95	1 at 25 2 at 15	20	Uniflux	Aboveground, 9% nickel	CBI	J. F. Pritchard	PRICO	1973
BOSTON GAS CO. Boston, Mass.	8.0	1000	290	187.5/125	3 at 62.5	8	Submrgd	Aboveground, 9% nickel	CBI	CBI	Expander	1968
BOSTON GAS CO. Boston, Mass.	—	1120	331	—	—	—	—	Aboveground, aluminum	CBI	—	—	1971 — second tank
BOSTON GAS CO. Lynn, Mass.	7.85	1000	290	86.4/57.6	3 at 28.8	12	Submrgd	Aboveground, 9% nickel	PDM	Air Products & Chemicals, Inc.	MCR	1972
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY Vancouver, B.C.	2.5	625	180	150/100	3 at 50	6	Submrgd	Aboveground, 9% nickel	Pittsburgh Des Moines Steel	Air Liquide	TEALARC	1971
BROOKLYN UNION GAS CO. Brooklyn, N.Y.	5.68	625	175	100	2 at 50	4	Direct Fired	Aboveground, 9% nickel	CBI	American Messer	Expander	1968
BROOKLYN UNION GAS CO. Brooklyn, N.Y.	—	1000	290	50	2 at 25	—	Direct Fired	Aboveground, 9% nickel	CBI	—	—	1971 — second tank
				125	2 at 62.5	—	Submrgd					1979
				125	2 at 62.5	—	Submrgd					
CHATTANOOGA GAS CO. Chattanooga, Tenn.	10.0	1200	348	90/60	3 at 30	20	Direct Fired	Aboveground, 9% nickel	PDM	J. F. Pritchard	PRICO	1973
CITIZENS GAS & COKE UTILITY Beech Grove, Ind.	5.0	1000	290	160	3 at 60	5	Submrgd	Aboveground, aluminum	PDM	Air Liquide	TEALARC	1972
COMMONWEALTH NATURAL GAS CO., Tidewater, Va.	8.0	1200	348	105	3 at 35	11	Direct Fired	Aboveground, 9% nickel	PDM	Envirogenics	Cascade	1972
CONNECTICUT NATURAL GAS CORP., Rocky Hill, Con.	6.6	1200	348	80/55	2 at 25 1 at 30	24	Vapor Trstr Submrgd	Aboveground, 9% nickel	PDM	Airco Cryoplants	Expander/ Nitrogen	1972
CONSOLIDATED EDISON CO. Astoria, N.Y.	8.0	1750	290	300/240	5 at 60	4	N.A.	Aboveground, 9% nickel	PDM	Airco Cryoplants	Expander/ Nitrogen	1974
DELMARVA POWER & LT. CO. Wilmington, Del.	1.71	280	72.5	50	2 at 25	5	Direct Fired	Aboveground, aluminum	CBI	Lotepro-Linde AG	Expander/ Nitrogen	1972
EAST TENNESSEE NATURAL GAS CO. Fordtown, Tenn.	9.5	1200	348	150	2 at 75	8	Direct Fired	Aboveground, aluminum	CBI	CBI	MRL	1975
ENERGY TERMINAL SERVICES CORP., Staten Island, N.Y. (Conversion of part of terminal capacity to peakshaving. Uses two storage tanks and all of vaporization capacity.)	39.0	6080	1800	300	2 at 60 2 at 120	8	Direct Fired	Prestressed concrete	Preload/Walsh	NA	NA	1982 planned
FALL RIVER GAS CO. Fall River, Mass.	0.5	150	45	10	1	15	Direct Fired	Aboveground, 9% nickel	PDM	CVI Corp.	Dual J. T. Cycle	1970
GAS LIGHT CO. OF COLUMBUS Columbus, Ga.	1.7	500	145	60	2 at 30	8	Indirect Fluid	Aboveground, aluminum	CBI	CBI	Expander	1974
GAZ METROPOLITAIN, INC. Montreal, Que., Canada	10.0	1000	290	180	3 at 60	16	Submrgd	Aboveground, 9% nickel	Horton (CBI)	Air Liquide	TEALARC	1969
GAZ METROPOLITAIN, INC. Montreal, Que., Canada	—	1000	290	—	—	—	—	Aboveground, 9% nickel	Horton (CBI)	—	—	1972 — second tank
INTERMOUNTAIN GAS CO. Boise, Idaho	4.0	600	175	90/60	3 at 30	10	Submrgd	Aboveground, aluminum	PDM	Lotepro-Linde AG	Expander/ Nitrogen	1974
IOWA-ILLINOIS GAS & ELEC. CO. Bettendorf, Iowa	2.0	500	145	50	2 at 25	10	Uniflux	Aboveground, aluminum	CBI	CBI	MRL	1972
IOWA POWER & LT. CO. Des Moines, Iowa	2.0	400	116	30	2 at 15	13	Intermed. Fluid	Aboveground, aluminum	CBI	CBI	MRL	1975
IOWA PUBLIC SERVICE CO. Waterloo, Iowa	2.5	400	117	30	2 at 15	26	Intermed. Fluid	Aboveground, aluminum	PDM	APCO (prime) Air Liquide (liquefaction)	TEALARC	1978
IOWA PUBLIC SERVICE CO. Waterloo, Iowa	—	400	117	—	—	—	—	Aboveground, aluminum	CBI	—	—	1978 — second tank
KOKOMO GAS & FUEL CO. Kokomo, Ind.	1.3	400	116	30/15	2 at 15	26	Intermed. Fluid	Aboveground, aluminum	CBI	CBI	Expander	1973
KOKOMO GAS & FUEL CO. Kokomo, Ind.	1.25	—	—	—	—	—	—	(Second liquefaction unit)		CBI	MRL	1974
LONG ISLAND LIGHTING CO. Holbrook, N.Y.	3.0	600	175	200/150	4 at 50	4	Subm. jet	Aboveground, 9% nickel	PDM	Lotepro-Linde AG	Cascade/ Mixed Refrigerant	1971
LOWELL GAS CO. Lowell, Mass.	4.5	1000	290	70/70	2 at 30 1 at 10	16	Direct Fired	Aboveground, 9% nickel	Graver/ Envirogenics	Envirogenics	Expander	1969
MEMPHIS LIGHT, GAS & WATER DIV., Memphis, Tenn.	5.0	1000	290	201	3 at 67	9	Submrgd	Aboveground, 9% nickel	CBI	Air Liquide	Cascade	1967
METRO. UTILITIES DISTRICT Omaha, Nebr.	8.0	1000	250	60/30	2 at 30	33	Submrgd	Aboveground, 9% nickel	CBI	Lotepro-Linde AG	Expander/ Nitrogen	1975
MINNESOTA GAS CO. Burnsville, Minn.	5.0	1000	290	60	2 at 40	12	Intermed. Fluid	Aboveground, 9% nickel	CBI	CBI	MRL	1978
NORTH CAROLINA NATURAL GAS CORP. Johnson County, N. Car.	3.5	735	212	60	1		Submrgd	Aboveground, 9% nickel	—	—	—	1984 — Planned
NORTHERN IND. PUBLIC SERVICE CO. La Porte, Ind.	10.0	2000	580	300/200	3 at 100	10	Direct Fired	Aboveground, 9% nickel	CBI	J. F. Pritchard	PRICO	1974
NORTHERN IND. PUBLIC SERVICE CO. La Porte, Ind.	10.0	2000	580	300/200	3 at 100	10	Submrgd	Aboveground	CBI	Lotepro	Mixed Refrigerant	1981
NORTHERN & CENTRAL GAS CO. Hagar, Ontario	2.5	625	180	85	3 at 42.5	7	Submrgd	Aboveground, 9% nickel	Horton (CBI)	Air Liquide	TEALARC	1968
NORTHERN & CENTRAL GAS CO. Hagar, Ontario	—	—	—	—	1 at 42.5	—	Submrgd	Aboveground, 9% nickel	Horton (CBI)	Lotepro Engr.	—	1977
NORTHERN NATURAL GAS CO. Wrenshall, Minn.	10.0	2165	630	200	2 at 100	10	Submrgd	Aboveg.ound, 9% nickel	PDM	SD Plants	TEALARC	1975
NORTHERN NATURAL GAS CO. Ventura, Iowa	14.5	2165	630	300	3 at 100	7	Submrgd	Aboveground, 9% nickel	PDM	NNG	PRICO	1978
NORTHERN STATES POWER CO. Eau Claire, Wisc.	2.0	270	78	24/24	2 at 12 3 at 3a	11	Direct Fired	Aboveground, aluminum	CBI	CBI	Expander	1969
NORTHERN STATES POWER CO. Wescott, Minn.	10.0	2130	580 (2 x 290) (1 x 32)	130	2 at 24	23	Direct Fired	Aboveground, 9% nickel	CBI	CBI	MRL	1972, 1975
NORTHWEST NATURAL GAS CO. Portland, Ore.	2.5	625	175	200	2 at 60 1 at 20 2 at 30	16	Direct Fired Submrgd	Aboveground, aluminum	CBI	CBI	Expander	1969
NORTHWEST NATURAL GAS CO. Newport, Ore.	5.0	1200	348	100/100	2 at 50	12	Submrgd	Aboveground, 9% nickel	CBI	CBI	MRL/ CRYEX	1977
NORTHWEST PIPELINE CORP. Plymouth, Wash.	8.0	1200	348	225	3 at 75	8	Submrgd	Aboveground, aluminum	PDM	Air Liquide	TEALARC	1975
NORTHWEST PIPELINE CORP. Plymouth, Wash.	8.0	1200	348	75	1 at 75	16	Submrgd	Aboveground, 9% nickel	PDM	Air Liquide	TEALARC	1979
PEOPLES GAS, LIGHT & COKE Fisher, Ill.	10.0	2000	580 (2 x 290)	300/200	3 at 67 1 at 100	19	Direct Fired	Aboveground, aluminum	CBI	CBI	Expander	1972
PHILADELPHIA ELECTRIC CO. West Conshohocken, Pa.	8.6	1200	348	310/186	5 at 62	4	Submrgd	Aboveground, 9% nickel	CBI	Airco Cryoplants	Expander/ Nitrogen	1972
PHILADELPHIA GAS WORKS Philadelphia, Pa.	25.0	4000	1160 (2 x 580)	500/400	5 at 100	10	Intermed. Fluid	Aboveground, Prestressed concrete	Preload	J. F. Pritchard	Cascade	1969 — Plant operable; 1974 on tanks
PIEDMONT NATURAL GAS CO. Charlotte, N. Car.	5.0	1000	290	150	3 at 50	7	Direct Fired	Aboveground, 9% nickel	CBI	CBI	MRL	1973

Cont'd U.S. and Canadian LNG Peakshaving Facilities

Company and Plant Site	Liquefaction Plant Capacity, MMcf/day	Storage Capacity, Mcf	Storage Capacity, MMcf	Total Design Capacity	Regasification — MMcf/d Rate	Regasification — MMcf/d No. of Days	Regasification — MMcf/d Type	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
PUBLIC SERVICE CO. OF NORTH CAROLINA, Cary, N. Car.	3.0	1000	290	100	2 at 50	6	Inter. Fluid	Aboveground, 9% nickel	CBI	CBI	MRL	1978
ROANOKE GAS CO. Roanoke, Va.	1.0	250	68.5	20	2 at 10	13	Intermed. Fluid	Aboveground, aluminum	CBI	CBI	MRL	1972
SAN DIEGO GAS & ELECTRIC CO. Chula Vista, Calif. No. 1 Plant	2.0	625	175	120/60	2 at 60	10	Submrgd	Aboveground, 9% nickel	CBI	American Messer	Expander	1965
SAN DIEGO GAS & ELECTRIC CO. Chula Vista, Calif. No. 2 Plant	7.0	1200	346	180/125	3 at 60	10	Submrgd	Aboveground, 9% nickel	CBI	Airco Cryoplants	Expander/ Nitrogen	1970
SOUTH CAROLINA LNG CO. Bushey Park, So. Car.	6.0	1000	290 (2 x 145)	60	2 at 30	17	Intermed. Fluid	Aboveground, aluminum	PDM	APCO (prime) Air Liquide	TEALARC	1978
SOUTHERN CONNECTICUT GAS CO., Milford, Conn.	6.6	1200	346	90	2 at 30 1 at 30	14	Vapor Trnsf. Submrgd	Aboveground, 9% nickel	PDM	Airco Cryoplants	Expander/ Nitrogen	1972
SOUTHWEST GAS CORP. Lovelock, Nev.	5.0	1000	290	165/70	3 at 35	10	Submrgd	Aboveground, 9% nickel	CBI	CBI	MRL	1982 — U.C.
TENNESSEE NATURAL GAS LINES, INC., Nashville, Tenn.	5.0	1000	290	150/100	3 at 50	10	Direct Fired	Aboveground, aluminum	CBI	CBI	MRL	1973
TEXAS EASTERN TRANS. CO. Staten Island, N.Y.	7.65	2000	600	292/195	3 at 97.5	10	Direct Fired	Aboveground, 9% nickel both walls	N.A.	Texas Eastern Cryogenics	TEALARC	1970; storage destroyed 1973; new double-wall tank — planned on same foundation
TRANSCONTINENTAL GAS, P.L. CORP., Hackensack, N.J.	7.0	1000	290	200/200	2 at 100	5	Intermed. Fluid	Aboveground, aluminum	CBI	J.F. Pritchard	Cascade	1968; 1970 on new tank
TRANSCONTINENTAL GAS P.L. CORP., Hackensack, N.J.	—	1000	290	200/200	2 at 100	—	Uniflux	Aboveground, 9% nickel	PDM	—	—	1974 — second tank
UGI CORP. Temple, Pa.	2.0	250	73	30/30	3 at 10	9	Submrgd	Aboveground, 9% nickel	PDM	Airco Cryoplants	Expander	1973 (1972 as satellite)
UTILITIES BOARD Trussville, Ala.	5.0	400	116	20	2 at 10	—	Intermed. Fluid	Aboveground, Aluminum	CBI	CBI	MRL/ CRYEX	1976
WISCONSIN NATURAL GAS CO. Oak Creek, Wisc.	0.75	250	72	50/25	2 at 25	10	Intermed. Fluid	Aboveground, aluminum	CBI	CBI	Cascade	1965

International LNG Peakshaving Facilities

Company and Plant Site	Liquefaction Plant Capacity, MMcf/day	Storage Capacity, Mcf	Storage Capacity, MMcf	Total Design Capacity	Regasification — MMcf/d Rate	Regasification — MMcf/d No. of Days	Regasification — MMcf/d Type	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
BRITISH GAS CORP. Avonmouth, Avon	10.0	1000	290	270	3 at 90	4	Submrgd	Aboveground, aluminum	Wheeoe, Ltd.	Cryoplants, Ltd.	MCR	1978 — Plant 1979 — Tank
BRITISH GAS CORP. Avonmouth, Avon	—	1000	290	180	2 at 90	—	Submrgd	Aboveground, 9% nickel	Motherwell Bridge Engrg. Ltd.	—	—	1979 — Second tank
BRITISH GAS CORP. Avonmouth, Avon	—	1000	290	90	1	—	Submrgd	Aboveground, 9% nickel	N.A.	—	—	1983 — Planned
BRITISH GAS CORP. Glenmavis, Scotland	5.0	1000	290	240	4 at 60	4	Submrgd	Aboveground, 9% nickel	Motherwell Bridge Engrg. Ltd.	Cryoplants, Ltd.	MCR	1974 — (North Sea Gas)
BRITISH GAS CORP. Glenmavis, Scotland (2nd plant)	10.0	1000	290	120	2 at 60	17	Submrgd	Aboveground, 9% nickel	Motherwell Bridge Engrg. Ltd.	Cryoplants, Ltd.	MRC	1972
BRITISH GAS CORP. Partington, Cheshire, England	10.0	2000	580 (2 x 290)	450	5 at 90	4	Submrgd	Aboveground, 9% nickel	Wm. Neill & Son (St. Helens) Ltd. (PDM Lic.)	Cryoplants, Ltd.	MRC	1973
BRITISH GAS CORP. Partington, Cheshire, England (2nd plant)	10.0	2000	580 (2 x 290)	270	3 at 90	2	Submrgd	Aboveground, aluminum	Wheeoe, Ltd.	Cryoplants, Ltd.	MRC	1974 on tank 1975 on plant
BRITISH GAS CORP. Isle of Grain, Kent	10.0	2000	580 (2 x 290)	360	3 x 130	5	Direct Fired	Aboveground, 9% nickel	Motherwell Bridge Engrg. Ltd.	Petrocarbon Development Ltd.	Open Expander	1981
BRITISH GAS CORP. Isle of Grain, Kent	10.0	2000	580 (2 x 290)	360	3 x 130	5	Direct Fired	Aboveground, 9% nickel	Wheeoe, Ltd.	Petrocarbon Development, Ltd.	Nitrogen Expander	1982
BRITISH GAS CORP. Dynevor Arms, S. Wales	10.0	1000	290	180	2 x 90	5	N.A.	Aboveground	N.A.	Snamprogetti	TEALARC	1983 — U.C.
BRITISH GAS CORP. Canvey Island, England	10.3	—	—		(Production plant only) (Reliquefaction)			—	—	Air Products, Ltd.	APCI-MCR	1972
N.V. NEDERLANDSE GASUNIE Maasvlakte, The Netherlands	12.4	2720	800 (2 x 430)	930	6 at 90 3 at 78	4	Submrgd	Aboveground, 9% nickel	Nederhorst Steel (PDM Lic.)	Linde A.G.	Expander/ Nitrogen	1977
DISTRIGAZ, S.A. Zeebrugge, Belgium	12.3	2480	715 (2 x 358)	391	5	6	Submrgd	Aboveground, 9% nickel	Boelwerft/ CMP/CBI	Linde A.G.	Nitrogen/ Expander	1978
STUTTGART CITY UTILITIES Stuttgart, W. Germany	3.4	865	193	88.9	3	10	Submrgd	Aboveground, 9% nickel	Linde A.G.	Linde A.G.	Open Mixed Refrigerant	1971 — Peakshaving plant
THYSSEN GAS GmbH Duisburg, Hamborn, W. Germany	2.1	550	145	135/90	3 at 45	8.5	Scomrgd	Aboveground, 9% nickel	CBI	CBI	MRL	1976
GAS & FUEL CORP. OF VICTORIA Dandenong, Victoria, Australia	5.0	500	145	125	2 at 62.5	4	Submrgd	Aboveground, 9% nickel	CBI Pty. Ltd.	Cryoplants, Ltd.	MRC	1979

EUROPEAN SATELLITE PEAKSHAVING FACILITIES

Company	Plant Location	LNG Source	Storage Volume Mcf	Storage Volume MMcf	Sendout Capacity MMcf/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
British Gas Corp.	Ambergate, Derbyshire England	Imported LNG From Canvey Island	265	72	64	Field Erected aluminum	Wheeoe, Ltd.	Wheeoe, Ltd. (Helium Expander Reliquefaction)	1980
British Gas Corp.	Anthech, Anglesey, Wales, U.K.	British Gas Corp. Glenmavis, Scotland	0.399	0.0117	0.360	Shop fabricated, 9% nickel	Air Products, Ltd.	British Gas Corp., Wales Region	1975
British Gas Corp.	Skrarvaar, Wigtownshire, Scotland, U.K.	British Gas Corp. Glenmavis, Scotland	3.535	1.037	1.200	Shop fabricated, stainless steel	Cryoplants, Ltd.	British Gas Corp., Scottish Region	1973
British Gas Corp.	Oban, Argyll, Scotland, U.K.	British Gas Corp. Glenmavis, Scotland	3.434	1.007	0.480	Shop fabricated, 2 tanks, stainless steel; 1 tank, 9% nickel	Tank Chapman, Ltd. Air Products, Ltd.	British Gas Corp. Scottish Region	1972
British Gas Corp.	Tobermory, Mole, Scotland, U.K.	British Gas Corp. Glenmavis, Scotland	4.545	1.332	1.200	Shop fabricated, 9% nickel	Air Products, Ltd.	British Gas Corp., Scottish Region	1975
British Gas Corp.	Dunoon, Argyll, Scotland, U.K.	British Gas Corp. Glenmavis, Scotland	6.060	1.777	1.920	Shop fabricated, 9% nickel	Air Products, Ltd.	British Gas Corp., Scottish Region	1973
British Gas Corp.	Dingwall Ross, Scotland, U.K.	British Gas Corp. Glenmavis, Scotland	1.769	0.518	0.360	Shop fabricated, stainless steel	Cryoplants, Ltd.	British Gas Corp., Scottish Region	1974
British Gas Corp.	Campbeltown, Argyll, Scotland, U.K.	British Gas Corp. Glenmavis, Scotland	4.545	1.332	0.900	Shop fabricated, 2 tanks, 9% nickel; 1 tank, stainless steel	Air Products, Ltd. Cryoplants, Ltd.	British Gas Corp., Scottish Region	1974
British Gas Corp.	Moffat, Dumfriesshire, Scotland, U.K.	British Gas Corp. Glenmavis, Scotland	1.765	1.765	0.350	Shop fabricated, stainless steel	Cryoplants, Ltd.	British Gas Corp., Scottish Region	1975

Cont'd EUROPEAN SATELLITE PEAKSHAVING FACILITIES

Company	Plant Location	LNG Source	Storage Volume Mbbl	Storage Volume Mbbl	Sendout Capacity Mbbl/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Gaz de France	Nantes, Loire-Atlantique France	Gaz de France LeHavre, France	50.3	15.7	17.0	Field erected, 1 tank, 9% nickel, 3145 bbl; 1 tank, concrete/liner, 12,579 bbl	Creusot — Loire Gaz Transport	Gaz de France	1966
Gaz de France	Granville, Manche, France	Gaz de France La Havre, France	11.1	3.5	35.3	Field erected, 9% nickel	Bignier-Smidt-Laurent	Gaz de France	1976
Erdgas Sudbayern GmbH	Geretsried, W. Germany	Technische Werke der Stadt Stuttgart, W. Germany	2.1	0.629	1.7	Shop fabricated	Linde AG	Linde AG	1974
Technische Werke der Stadt Stuttgart	(Truck)	Technische Werke der Stadt Stuttgart, W. Germany	0.880	0.258	0.848	Truck transport	Linde AG and Aurepa	Technische Werke der Stadt Stuttgart	1976
Thyssengas GmbH	(Truck)	Thyssengas Duisberg-Hamborn W. Germany	0.645	0.189	0.848	Truck transport	Aurepa	Thyssengas	1977
Gas Figueras S.A.	Gerona, Spain	ENAGAS Barcelona, Spain	4.385	1.26	0.056	Shop fabricated, stainless steel	Mecanica de la Pena	Erhan	1971
Gas Costa Brava E.A.	Gerona, Spain	ENAGAS Barcelona, Spain	0.877	0.252	0.252	Shop fabricated, stainless steel	Maquinista Terrestrey Maritima	British Oxygen	1977
Gas Tarraconense S.A.	Tarragona, Spain	ENAGAS Barcelona, Spain	1.315	0.378	0.112	Shop fabricated, stainless steel	Air Liquide Spain		1977
Sugranes Gres Catalan S.A.	Barcelona, Spain	ENAGAS Barcelona, Spain	5.262	1.512	0.196	Shop fabricated, stainless steel	Air Liquide Spain		1973
Colonia Cuell S.A.	Gerona, Spain	ENAGAS Barcelona, Spain	1.754	0.504	0.037	Shop fabricated, stainless steel	Maquinista Terrestrey Maritima	British Oxygen	1977
Gas Calra, S.A.	Gerona, Spain	ENAGAS Barcelona, Spain	1.315	0.378	N.A.	Shop fabricated, stainless steel	N.A.	N.A.	1977
Termica Cubellas	Tarragona, Spain	ENAGAS Barcelona, Spain	0.438	0.126	0.009	Shop fabricated, stainless steel	Air Liquide Espanola	Air Liquide Espanola	1978

NA = Not Available

LNG Satellite Peakshaving Facilities Small Capacity Plants — Shop Builtup Components

Company	Plant Location	LNG Source	Storage Volume Mbbl	Storage Volume Mbbl	Sendout Capacity Mbbl/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Bay State Gas Co.	Marshfield, Mass.	Bay State, Distrigas	9.0	110	10.0	Shop builtup cylinders	Process Eng.	Gas, Inc.	1971
City of Brownsville Gas Dept.	Brownsville, Tenn.	Memphis LG&W	0.5	6	10.0	Trailer shuttle	Ryan Industries	City of B'ville Gas Dept.	1970
Cape Cod Gas Co.	South Yarmouth, Mass.	Lowell Gas Co.	5.2	63.5	0.6	Shop builtup cylinder	Process Eng.	Process Eng.	1970
Cape Cod Gas Co.	Wareham, Mass.	Lowell Gas Co.	9.0	110	2.9	Shop builtup cylinder	Process Eng.	Gas, Inc.	1974, 1978
Concord Natural Gas Corp.	Concord, N.H.	Bay State Gas Co.	4.5	55	4.8	Shop builtup cylinders	Process Eng.	Gas, Inc.	1974
Consumers Gas Co.	Arnprior, Ont., Can.	Gaz Metropolitan	4.5	55	4.8	Shop builtup cylinders	Process Eng.	Gas, Inc.	1978
DeKalb-Cherokee Counties Gas District	Fort Payne, Ala.	Chattanooga Gas Co.	4.5	55	2.2	Shop builtup cylinders	LOX Equip.	Ladd Eng. Assoc.	1972
Elizabethtown Gas Co.	Hackettstown, N.J.	Transco	1.7	21	5.8	Shop builtup cylinder	Process Eng.	PDM	1971
Fitchburg Gas & Electric Light	Westminster, Mass.	Lowell Gas Co.	4.5	55	5.0	Shop builtup cylinders	Process Eng.	Gas, Inc.	1974
Gas Service Inc.	Nashua, N.H.	New England LNG	4.5	55	7.2	Shop builtup cylinders	Process Eng.	Gas, Inc.	1973
Holyoke Gas Department	Holyoke, Mass.	Lowell Gas Co.	18.0	220	12.0	Shop builtup cylinders	Process Eng.	Gas, Inc.	1971
Lawrence Gas Co.	Lawrence, Mass.	Lowell Gas Co.	12.3	150	18.9	Shop builtup cylinder	H.L. Johnson	Gas, Inc. and Smith & Horrington	1969, 1972
Lowell Gas Co.	Wilmington, Mass.	Lowell Gas Co.	2.5	30	12.0	Shop builtup cylinders	H.L. Johnson	Gas, Inc.	1971
Lowell Gas Co.	Westford, Mass.	Lowell Gas Co.	4.5	55	6.0	Shop builtup cylinder	Process Eng.	Gas, Inc.	1972, 1974
Manchester Gas Co.	Manchester, N.H.	New England LNG Co.	4.5	55	6.0	Shop builtup cylinders	Process Eng.	Process Eng.	1975
Middleboro Gas & Electric Dept.	Middleboro, Mass.	Lowell Gas Co.	2.5	30	5.0	Shop builtup cylinder	Process Eng.	Gas, Inc.	1970
Hartford Elec. Lt. Co.	Torrington, Conn.	Distrigas & New England LNG Co.	4.5	55	3.0	Shop builtup cylinder	Ryan Industries	N.E. Utilities	1972
Hartford Elec. Lt. Co	Stamford, Conn.	Distrigas & New England LNG Co.	4.5	55	4.8	Shop builtup cylinders	Ryan Industries	N.E. Utilities	1972
Hartford Elec. Lt. Co.	Danbury, Conn.	Distrigas & New England LNG Co.	9.0	110	3.6	Shop builtup cylinders	Ryan Industries	N.E. Utilities	1972
Connecticut Lt. & Power Co.	Montville, Conn.	Distrigas & New England LNG Co.	4.5	55	2.2	Shop builtup cylinders	Process Eng.	Gas, Inc.	1972
Connecticut Lt. & Power Co.	Waterbury, Conn.	Distrigas & New England LNG Co.	12.4	165	7.2	Shop builtup cylinders	Ryan Industries	N.E. Utilities	1972
Connecticut Lt. & Power Co.	Norwalk, Conn.	Distrigas & New England LNG Co.	4.5	55	2.4	Shop builtup cylinders	Ryan Industries	Conn L&P	1975
Northern Utilities Inc.	Lewiston, Me.	New England LNG Co.	12.4	165	7.2	Shop builtup cylinders	Process Eng.	Applied Engineering; Gas, Inc.	1971, 1975, 1977
City of Norwich (Conn.) Dept. of Public Utilities	Norwich, Conn.	New England LNG Co.	4.5	55	7.2	Shop builtup cylinders	Process Eng.	Gas, Inc.	1972
Piedmont Natural Gas Company	Lenoir, N.C.	American LNG Corp.	4.5	55	2.2	Shop builtup cylinders	Process Eng.	Process Eng.	1971
Savannah Public Utility Dept.	Savannah, Tenn.	Chattanooga Gas Co.	0.85	11	1.5	Trailer shuttle	Process Eng.	Process Eng.	1973
United Cities Gas Co.	Murfreesboro, Tenn.	Chattanooga Gas Co.	4.5	55	0.2	Shop builtup cylinders	Process Eng.	Process Eng.	1973
UGI Corporation	Hazleton, Pa. (portable)	UGI Corp. Temple, Pa.	0.85	11	2.0	Trailer shuttle	Process Eng.	Cryodynamics	1974
Westfield Gas Dept.	Westfield, Mass.	Lowell Gas Co.	9.0	110	12.0	Shop builtup cylinders	Process Eng.	Gas, Inc.	1971, 1974
Wisconsin Gas Co.	Rice Lake, Wis.	Northern States Power	18.0	220	7.2	Shop builtup cylinders	Process Eng.	Gas, Inc.	1974
Middle Tennessee Natural Gas Authority	Smithville, Tenn.	Memphis LG&W Div.	1.8	22	0.09	Trailer shuttle	American LNG Co.	American LNG Co.	1975

LNG Satellite Facilities in Japan

Company	Plant Location	LNG Source	Storage Volume MMcf	Storage Volume MMbl	Sendout Capacity MMcf/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Tokyo Gas Co.	Hitachi, Ibaragi	Tokyo Gas Co. Negishi/Sodegaura	31.3	9.20 (1 x 8.82) (1 x 0.38)	133.2 x 22 1 x 88	Field erected Shop fabricated	Hitachi Nippon Oxygen	Tokyo Gas Company	1970
Washinomiya Gas Co.	Washinomiya, Saitama	Tokyo Gas Co. Negishi/Sodegaura	0.77	0.226 (2 x 0.113)	33 3 x 11	Shop fabricated	Tokyo Oxygen	Tokyo Gas Company	1971
Syoei Gas Co.	Higashimatsuyama Saitama	Tokyo Gas Co. Negishi/Sodegaura	0.43	0.126 (2 x 0.063)	10 2 x 5	Shop fabricated	Nippon Oxygen	Tokyo Gas Company	1975
Miho Gas Co.	Miho, Ibaragi	Tokyo Gas Co. Negishi/Sodegaura	1.29	0.378 (3 x 0.126)	66 3 x 22	Shop fabricated	Nippon Oxygen	Tokyo Gas Company	1977
Tokyo Gas Co.	Keiyo, Yumanashi	Tokyo Gas Co. Negishi	1.73	0.503	N.A.	Shop fabricated	Teikoku Oxygen; Nissan Kogyo	Tokyo Gas Company	1981

LNG Satellite Peakshaving Facilities Large Capacity Plants — Field Constructed K.D. Components

Company	Plant Location	LNG Source	Storage Volume MMcf	Storage Volume MMbl	Sendout Capacity MMcf/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Atlanta Gas Light Co.	Macon, Ga.	Southern Energy	1500	450.0	150.0	Aboveground, aluminum	CBI	Applied Engineering	1977
Austell Gas Dept.	Austell, Ga.	American LNG Corp.	80	23.3	20.0	Aboveground, aluminum sphere	CBI	CBI	1972
Bay State Gas Co.	Easton, Mass.	Distrigas	800	225.0	35.0	Aboveground, aluminum	CBI	CBI	1972
Boston Gas Co.	Salem, Mass.	Boston Gas	1000	290.0	30.0	Aboveground, 9% nickel	PDM	PDM	1972
Cape Cod Gas Co.	South Yarmouth, Mass.	Lowell Gas Co.	175	51.5	20.0	Prestressed concrete w/liner	Walsh Construction	Gas, Inc.	1971
Chicago Bridge & Iron Co.	Cordova, Ala.	American LNG Corp.	45	13.0	3.5	Aboveground, aluminum sphere	CBI	CBI	1975
Elizabethtown Gas Co.	Elizabeth, N.J.	Transco	150	45.0	30.0	Aboveground, aluminum	PDM	PDM	1971
Fort Hill Natural Gas Authority	Fort Hill, S.C.	American LNG Corp.	35	10.0	12.0	Aboveground, aluminum sphere	CBI	CBI	1970
Haverhill Gas Co.	Haverhill, Mass.	Distrigas	400	114.0	24.0	Aboveground, aluminum	CBI	CBI	1972
Lynchburg Gas Co.	Lynchburg, Va.	Roanoke Gas Co.	42	12.0	7.2	Aboveground, aluminum sphere	Graver	Gas, Inc.	1976
New Bedford Gas & Edison Light Co.	Acushnet, Mass.	Hopkinton LNG Corp.	200	58.0	30.0	Aboveground, 9% nickel	PDM	Air Products	1971
New Bedford Gas & Edison Light Co.	Acushnet, Mass.	Hopkinton LNG Corp.	300	87.0	—	Aboveground, aluminum	CBI	—	1973 (2nd tank)
New Jersey Natural Gas Co.	Stafford Township, N.J.	Distrigas	100	28.5	20.0	Aboveground, aluminum	CBI	CBI	1971
New Jersey Natural Gas Co.	Howell Township, N.J.	Distrigas	400	117.0	60.0	Aboveground, aluminum	PDM	PDM	1974
Northern States Power Co.	LaCrosse, Wis.	NSP	130	37.0	12.0	Aboveground, aluminum	CBI	CBI	1969
Philadelphia Gas Works	Philadelphia, Pa.	PGW	250	73.0	88.8	Aboveground, 9% nickel	PDM	Envirogenics	1971
Providence Gas Co.	Exeter, R.I.	Distrigas	198	55.0	24.0	Aboveground, aluminum	Graver/ Envirogenics	Envirogenics	1972
Public Service Gas & Electric Co.	Burlington Township, N.J.	Distrigas	350	100.0	75.0	In-ground, aluminum	CBI	Envirogenics	1972
Springfield Gas Utility	Springfield, Tenn.	Various	20	5.0	4.8	Aboveground, aluminum sphere	PDM	PDM	1974
South Jersey Gas Co.	McKee City, N.J.	Distrigas	400	116.0	60.0	Aboveground, aluminum	CBI	CBI	1972
Valley Gas Co.	Cumberland, R.I.	New England LNG Co.	87	25.0	12.5	Prestressed concrete w/liner	LNG Co	Gas, Inc.	1971

U.S. Remote Supply Projects

Company	Plant Location	Origin of Liquid	Site Storage, M gal	Site Vaporization MMcf/hr
San Diego Gas & Electric Co.	Borrego Springs, Calif.	Peakshaving facility at Chula Vista, Calif.	7.75	9
San Diego Gas & Electric Co.	Alpine Village, Calif.	Peakshaving facility at Chula Vista, Calif.	25	30
San Diego Gas & Electric Co.	Camp Pendleton, Calif.	Peakshaving facility at Chula Vista, Calif.	50	90

International Baseload LNG Liquefaction Facilities

Company and Plant Site	Liquefaction Plant Capacity, MMcf/day	Storage Capacity, MMcf	Storage Capacity, MBbl	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
ARCTIC PILOT PROJECT Bridport Inlet, Melville Island, Canada	275 (Barge-mounted)	N.A.	1257	N.A.	N.A.	N.A.	Precooled TEALARC	1985
CAMEL (GL 4-Z) Arzew, Algeria	200.0	1840 total	210 (3 x 70) 310	Aboveground, (2-aluminum, 1-9% nickel) Frozen hole	CBI lic. Pritchard	TECHNIP Pritchard	Cascade	1963 et seq. LNG for export to England, France
SONATRACH — (GL 1-Z) Arzew, Algeria	1100.0	7000	1890 (3 x 630 tanks)	Aboveground, 9% nickel	Toyo Kanetsu, K.K., (PDM Lic.)	Bechtel Corp. & Chemico	APCI-MCR	1978
SONATRACH — (GL 2-Z) Arzew, Algeria	1000	6000 (3 x 800)	1800	Aboveground, 9% nickel	Toyo Kanetsu K.K., (PDM Lic.)	Pullman Kellogg	APCI-MCR	1982
SONATRACH — (GL 1-K) Skikda, Algeria	430.0 (3 trains)	2500	700 (2 x 350)	Aboveground, 9% nickel	CMP/CBI	TECHNIP	TEALARC	1972
SONATRACH — (GL 2-K) Skikda, Algeria	170.0 (1 train)	1250	350	Aboveground, 9% nickel	CBI	Pullman-Kellogg	PRICO	1981
SONATRACH — (GL 3-K) Skikda, Algeria	350.0 (2 trains)	3500	[illegible] (2 x 440)	Aboveground, 9% nickel	CBI/Whessoe	Pullman-Kellogg	PRICO	1982
SIRTE OIL CO. Marsa el Brega, Libya	385.0	2100	630 (2 x 315)	Aboveground, 9% nickel	CBI	Esso R&E-Bechtel — SNAM Progetti	APCI-MCR	1970
BRUNEI LNG Lumut, Brunei, Borneo	750.0	4050	1131 (3 at 377)	Aboveground, 5% nickel	Toyo Kanetsu K.K., (PDM Lic.)	Japan Gasoline Co. — UOP	APCI-MCR	1973
ABU DHABI GAS LIQUEFACTION CO. LTD., Das Island, Abu Dhabi	350.0	6600	1920 (2 x 960)	Aboveground, 9% nickel	I.H.I.	Bechtel-Chiyoda	APCI-MCR	1977
ABU DHABI GAS LIQUEFACTION CO. LTD., Das Island, Abu Dhabi		5033	1510 (3 x 503)	Composite	CBI	—	—	1985 — U.C. (Replacement for existing storage)
PHILLIPS-MARATHON Kenai, Alaska	185.0	2300	675 (3 x 225)	Aboveground, aluminum	CBI	Phillips-Bechtel	Cascade	1969
PERTAMINA/MOBIL Arun, N. Sumatra, Indonesia	1200	8350	3200 (4 x 800)	Aboveground, 9% nickel	Toyo Kanetsu K.K., (PDM Lic.)	Bechtel, Inc.	APCI-MCR	1978
PERTAMINA-MOBIL Arun, N. Sumatra, Indonesia	550	—	—			Chiyoda	APCI-MCR	1984 — U.C.
PERTAMINA/HUFFCO Badak, E. Kalimantan, Indonesia	550	8330	2400 (4 x 600)	Aboveground, 9% nickel	Hitachi Zosen — CBI	Bechtel, Inc.	APCI-MCR	1977
PERTAMINA/HUFFCO Badak, E. Kalimantan, Indonesia (expansion)	530	2777	800	Aboveground, 9% nickel	N.A.	Bechtel, Inc.	APCI-MCR	1983 — U.C.
MALAYSIAN LNG SDN. BHD. Bintulu, Sarawak, Malaysia	850	5660	1636 (4 x 409)	N.A.	I.H.I.	Pullman Kellogg — Japan Gasoline Co. Ltd.	API-MCR	1982 — U.C.
WOODSIDE LNG PTY. LTD. Withnell Bay, Western Australia	900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1987 — Planned

Import/Receiving Terminals

Company and Plant Site	Storage Capacity (Mdth)	Storage Capacity (Mdth)	Capacity	Regasification — Mdth/d Rate	Regasification — Mdth/d Type	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
BRITISH GAS CORP. Canvey Island, England	1400	392 (6 – 60 ÷ 2 – 16)	300	3 at 50 1 at 50 2 at 50	Submrgd Seawater Intermediate fluid/seawater	Frozen hole Aboveground, aluminum	Conch/McAlpine APV and Wiessalz	Gas Corp.	1956, 1963, 1967
GAZ DE FRANCE Montoir de Bretagne	5300	1512 (2 x 756)	910	4 at 228	Estuary water	Aboveground, concrete	Chantiers Modernes; Europe Etudes; Technigaz; Bignier-Schmidt-Laurent	Gaz de France	1981
GAZ DE FRANCE Montoir de Bretagne	2650	756	—	—	—	Aboveground, 9% nickel	C.M.P.	—	1983 — U.C.
GAZ DE FRANCE Le Havre, France	792	229.5 (3 x 76.5)	75	3 at 25	Seawater Fluid	Aboveground, 9% nickel	CBI lic.	Gaz de France	1983
GAZ DE FRANCE Fos-Sur-Mer, France	1500	450 (2 x 225)	424	4 at 106	Intermed. Fluid	Aboveground, aluminum	CBI lic.	Gaz de France	1971
GAZ DE FRANCE Fos-Sur-Mer	1000	280	425	—	—	Aboveground, 9% nickel	C.M.P.		1979 — third tank
ENAGAS, S.A., Barcelona	1800	500 (2 x 250)	155	1 at 67 2 at 44	Seawater	Aboveground, concrete	Preload/Christiani and Nielsen	Esso R&D	1986
	1800	500	288	2 at 67 2 at 67	Seawater submrgd	Aboveground, 9% nickel	Felguera Provence	CBI	1974
	1800	500	536	4 at 134	Seawater	Aboveground, concrete	Preload Ausimi	Preload Ausimi	1981
SNAM (ENI) La Spezia, Italy	2100	630 (2 x 315)	353	2 at 1765	Intermed. Fluid	Aboveground, 9% nickel	SAIPEM (PDM lic.)	Esso R&D	1969
DEUTSCHE FLUSSIGERD GAS TERMINAL Gmbh Wilhelmshaven, Ger.	5300	1508 (4 x 377)	2160	10 at 135	Submrgd/ seawater	Aboveground, concrete and 9% nickel	Dykerhoff Widmann — CMP	Linde A.G.	1990's — Planned
DISTRIGAZ, S.A. Zeebrugge, Belgium	9072	2520 (4 x 630)	1000	10 at 100	Submrgd	Half underground	N.A.	Tractabel	1986 — U.C.
TOKYO GAS CO./TOKYO ELECTRIC, Negishi, Yokohama, Japan	3460	1010 (2 x 284) (2 x 221)	224 56	4 at 56 1 at 56	Seawater Submrgd	Aboveground, 9% nickel	IHI	Tokyo Gas Co.	1969
	215	63	56	1 at 56	Submrgd	Inground concrete and SUS membrane	IHI		1970
	1287	378				Inground concrete and SUS membrane	IHI		1972
	979	284	191	1 at 93 1 at 49 1 at 49	Seawater Seawater Submrgd	Aboveground, 9% nickel	IHI	Tokyo Gas Co.	1972
	544	158				Aboveground, 9% nickel	IHI		1973
	2038	599	110	1 at 110	Submrgd	Inground concrete and SUS membrane	IHI/Kajima	Tokyo Gas Co.	1977
	2038	599	110	1 at 110	Submrgd	Inground concrete and SUS membrane	IHI/Kajima		1978
	2038	599	110	1 at 110	Seawater	Inground concrete and SUS membrane		Tokyo Gas Co.	1979
	2038	599				Inground concrete and SUS membrane	Nippon Kokan		1981
TOKYO GAS CO./TOKYO ELECTRIC, Sodegaura, Chiba, Japan	1931	568 (2 x 284)	330	3 at 66 2 at 66	Seawater Submrgd	Aboveground, Al	Kawasaki Heavy Industries IHI	Tokyo Gas Co.	1982 1973
	1287 2574	378 756 (2 x 378)	418	3 at 86 4 at 55	Seawater Seawater	Aboveground, Al	IHI	Tokyo Gas Co.	1974
	1931 2574	568 (2 x 284) 756 (2 x 378)				Inground concrete and SUS membrane Aboveground, Al	IHI IHI		1974 1975
	1287	378	340	2 at 110 1 at 60 1 at 60	Seawater Seawater Submrgd	Inground concrete and SUS membrane	IHI	Tokyo Gas Co.	1976
	2574	756 (2 x 378)				Aboveground, Al	IHI		1977
	5148	1512 (4 x 378)	613	2 at 110 2 at 131 1 at 131	Seawater Seawater Submrgd	Inground concrete and SUS membrane	IHI	Tokyo Gas Co.	1977
	2574	756 (2 x 378)				Inground concrete and SUS membrane	Kajima-MHI		1978
	2574	756 (1 x 391) (1 x 365)				Inground concrete and SUS membrane	IHI		1979
	2574	756 (2 x 378)				Inground concrete and SUS membrane	Kajima-MHI		1979
	1287	378				Inground concrete and SUS membrane	Kajima-IHI		1981
	9578	1840 (2 x 820)				Inground concrete and SUS membrane	MHI-Kajima IHI-Shimizu		1982
TOKYO GAS & TOKYO ELECTRIC Sodegaura, Japan	8348	2454 (3 x 818)	—	—	—	Aboveground, 9% nickel	IHI, MHI, NKK		1982
	3854	1132 (2 x 566)	—	—	—	Inground, concrete and SUS membrane	MHI and Kawasaki Heavy Industries		1982
OSAKA GAS CO. Senboku I, Osaka, Japan	3920	1120 (3 x 280) – underground) (1 x 280 – aboveground)	160	3 at 40 1 at 40	Seawater Intermed Fluid	Aboveground, aluminum (1) 9% nickel (2)	IHI	Osaka Gas	1971
						Inground concrete and SUS membrane	IHI/Ohbayashi		
OSAKA GAS CO. Senboku II, Osaka, Japan	16,368	4700 (10 x 470)	540	7 at 80 2 at 80	Seawater Thermal Fluid	Aboveground, aluminum (3) 9% nickel (7)	IHI and Toyo Kanetsu K.K	Osaka Gas	1977
	5194	2350 (5 x 470)	—	—	—	Aboveground, 9% nickel	N.A.	N.A.	N.A.
KITA KYUSHU LNG CO. Tobata, Fukuoka, Japan (Kyushu Electric/Nippon Steel)	7722	2268 (6 x 378)	678	4 at 142 1 at 110	Seawater Submrgd	Aboveground, 9% nickel	IHI Toyokanetsu	IHI	1977 1979
CHUBU ELECTRIC/TOHO GAS CO. Chita, Aichi, Japan	3218	1892 (2 x 473)	318 (2 x 473) (2 x 473)	3 at 142 1 at 88 4 at 22 1 at 22	Seawater Submrgd Seawater Submrgd	Aboveground, Al	IHI Toyokanetsu	IHI	1977
	5990	3500 (6 x 583)	—	—	—	Aboveground, 9% nickel	N.A.	N.A.	N.A.
KANSAI ELECTRIC/OSAKA GAS Himeji, Hyogo, Japan	2966	1761 (3 x 563) (1 x 252)	625	5 at 125	Seawater	Aboveground, 9% nickel — 2 tanks Aluminum — 1 tank	IHI	IHI	1979
	2965	1750 (3 x 563)	—	—	—	Aboveground Aluminum			
ALGONQUIN LNG INC. Providence, R.I.	2000	600	300	3 at 100	Direct Fluid	Aboveground, 9% nickel	N.A.	N.A.	N.A.
						Aboveground, 9% nickel	CBI	CBI	1973
COLUMBIA LNG CORP. & CONSOLIDATED SYSTEM LNG. CO., Cove Point, Maryland	5000	1500 (4 x 375)	1000 200	10 at 100 2 at 100	Intermed. Fluid	Aboveground, aluminum	PDM	Pullman Kellogg & Raymond Technical	1977
DISTRIGAS CORP. Everett, Mass.	3250	974 (1x374 + 1x600)	135	3 at 45	Submrgd	Aboveground, 9% nickel	CBI	CBI	1971
NATURAL GAS PIPELINE CO. OF AMERICA (Peoples Gas) Ingleside, Tex.	6804	1890 (3 x 630)	1124	11 at 104	Seawater Submrgd	Aboveground, 9% nickel	N.A.	N.A.	1990's — Planned
SOUTHERN ENERGY CO. Elba Island, Ga.	4000	1200 (3 x 400)	540	5 at 108	Submrgd	Aboveground, aluminum	CBI	Bechtel Inc. and Raymond Technical	1977
TRUNKLINE LNG CO. Lake Charles, La.	6600	1800 (3 x 600)	700	7 at 100	Submrgd	Aboveground, 9% nickel	PDM	Pullman Kellogg Co. and Raymond Technical	1981
WESTERN LNG TERMINAL CO. Little Cojo, Calif.	5775	1650 (3 x 550)	1200	12 at 100	Direct seawater	Aboveground, 9% nickel	N.A.	Fluor	1985 — Planned

International LNG Report

Future World LNG Trade Looks Good — Part 1

by P.J. Anderson, *Consulting Editor, Technology*

As 1982 draws to a close, development of international trade of LNG may be reaching a point where the growth curve becomes nearly flat. This slowed development may last until much later in the decade. In 1983 and 1984, we should see the implementation of two remaining projects under construction: Malaysia-Japan and the Indonesia-Japan expansions. No other project have progressed to where they can be implemented before 1986. Slippage appears to be the rule for these proposed projects.

This is not to say that growth in international trade in gas by pipeline or as LNG is over. According to the International Energy Agencies' forecast of natural gas use through the

TABLE 1.
Operational Base-Load LNG Import Projects

Trade	Contract Initial Delivery	Contract Term, yr	Companies Involved	Daily Gas Volume, MMcf
Algeria — France Arzew — Le Havre	1964	25	SONATRACH Gaz de France	50
Alaska — Japan Kenai — Negishi	1969	15*	Phillips Petroleum Co. Marathon Oil Co. Tokyo Electric Power Co. Tokyo Gas Co., Ltd.	135
Libya — Italy Marsa el Brega — La Spezia	1969	20	Sirete Oil Co. SNAM	235
Libya — Spain Marsa el Brega — Barcelona	1969	15	Sirete Oil Co. ENGAS	110
Brunei — Japan Lumut-Sodegura Negishi, Semboku	1972	20	Brunei LNG, Coldgas Trading Osaka Gas Co., Ltd., Tokyo Gas Co., Ltd., Tokyo Electric Power Co.	745
Algeria — France Skikda — Fos sur Mer	1973	25	SONATRACH Gaz de France	350
Algeria — U.S. Skikda — Everett	1971	20	SONATRACH Distrigas	115
Algeria — Spain Arzew — Barcelona	1976 (full delivery 1982)	23	SONATRACH Empresa Nacional de Gas	450
Abu Dhabi — Japan Das Island — Tokyo	1977	20	Abu Dhabi Liquefaction Co. Tokyo Electric Power Co.	355
Indonesia — Japan North Sumatra, East Kalimantan — Japanese Terminals	1977	20	Pertamina, Osaka Gas Co., Ltd., Kunsai Electric Power Co. Chubu Electric Power Co. Kyushu Electric Power Co. Nippon Steel	1085
Algeria — Belgium Arzew — Zeebrugge	1982	20	SONATRACH Distrigas, S.A.	250 until Jan. 1, 1986 (delivered to Montoir)
Algeria — U.S. Arzew — Lake Charles, LA.	1982	20	SONATRACH Trunkline Gas Co. Trunkline LNG Co.	450
Algeria — France Arzew — Montoir-de-Bretagne	1982	20	SONATRACH Gaz de France	530

*Five year extension applied for.

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year 2000, OECD demand for gas in the year 2000 will be between 1012 billion m^3 and 1235 billion m^3 – an annual growth rate of between 1% and 1½% from the 1980 level of 896 billion m^3.

In the year 2000, OECD production will account for between 706 and 1056 billion m^3 of requirements, leaving probable net imports from outside the OECD of between 179 and 306 billion m^3. Using these figures, imports will have increased at an annual rate of between 6% and 9%, several times the rate at which demand is expected to increase, from a 1980 level of 55 billion m^3. Firm plus potential imports in 2000 are cited at a level of 269 billion m^3. Of the firm imports, LNG is projected to account for 56 billion m^3 or 21%. That share, although still very respectable, is down from the 56% of imports that existed in 1980. Concerning potential imports, the IEA study calls for OECD gas imports to be 154 billion m^3 in the year 2000 of which 87 billion m^3 or 56% will be as LNG. This represents a significant volume that could be realized, which the LNG industry will seek to capture.

A study by the Economics Department of the Institut Francais du Petrole forecasts that international trade in gas will grow at an annual rate of 2 to 3% through the year 2000. It predicts that international trade will rise from the 200 billion m^3 level of 1980 to 450 to 650 billion m^3 over the 20-year period. Of this, LNG trade will grow from 32.5 billion m^3 in 1980 to between 200 and 300 billion m^3 at the turn of the century.

Whether LNG trade grosses at an annual rate of 8%, as the IEA projects for firm and potential imports, or 11%, as IFP forecasts, there will be substantial net growth in LNG world trade. Whether that growth takes place as a smooth curve or a step function will depend on a host of political and economic factors. These factors have been discussed at greath length in numerous articles. Therefore, in this article, we will look briefly at the status of the individual current and projected LNG trades.

Operational Projects

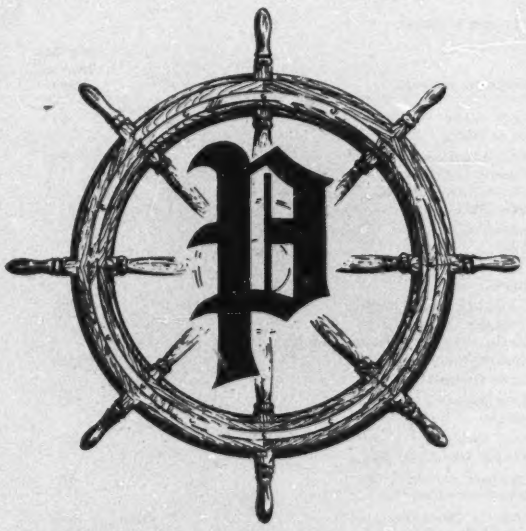
Currently operational projects are shown in Table 1. Included in this list is the Algeria-United States project, which involves Trunkline LNG and SONATRACH, and (initiated on Sept. 11 with the lifting of the first cargo) and the Algeria-Belgium project, which involves Distrigaz S.A. and SONATRACH, that was scheduled to begin in October with deliveries to Gaz de France's Montoir de Bretagne terminal. Deliveries to the Zeebrugge, Belgium, begin Jan. 1, 1986.

The volume of LNG represented by these projects is 4.85 billion cu ft per day (47.7 billion Nm^3/yr). Of this volume, 2.32 billion cu ft per day (22.8 billion Nm^3/yr) or 48% will be delivered to Japan, 1.98 billion cu ft per day (19.4 billion Nm^3/yr) or 41% to Europe, and the remaining 0.56 billion cu ft per day (5.5 billion Nm^3/yr) or 11% to the U.S. Asian sources would account for 38% of exports, North African sources 51%, Middle East 7%, and North America 3%, if contracted volumes were to be delivered.

Unfortunately, this was not the case. Deliveries from Asian nations, Alaska, and the Middle East to Japan were near or at contractual quantities. Those from North Africa to Europe were not.

Deliveries from Libya to Spain continued; those from Italy remained suspended. On Nov. 12, 1981, Exxon Corp. announced that it was withdrawing from all its oil and gas operations in Libya. This included the Marsa el Brega liquefaction plant. The Libyan National Oil Corp. is now operating that plant through a subsidiary, Sirte Oil Co. Exxon is providing transport for the LNG delivered to Spain under charter.

In reaching its amended pricing provisions, SONATRACH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delayed implementation of the Trunkline LNG and Gaz de France projects. Deliveries to Gaz de France began on March 19, 1982, with the arrival of the *Ramdane Abane* from Arzew at the Montoir de Bretagne terminal. Deliveries should be at full levels some time in 1983. Initial deliveries for Belgium's Distrigaz were to have been initiated in October through Montoir. Full delivery levels to Trunkline at Lake Charles are to be reached in December when six cargoes are to be delivered. Coincidentally, Gaz de France reached agreement on an amended pricing provision covering all of their contracts on Feb. 2, 1982, and Trunkline on Aug. 6.

The France-Algeria agreement, reached on a government-to-government basis, has not been disclosed. It is widely reported to include a base price of $5.10/million Btu FOB indexed on a dollar-for-dollar change of the market basket of crude oils. It is understood that the price includes both economic and political premium values. The economic portion is believed to be 86.5% of the price, and the political premium 13.5%. That price, revised quarterly, is understood to be approximately $4.77/MMBtu for the third quarter of 1982. The deescalation of $0.33/MMBtu reflects deescalation in the values of the crude oils. The FOB price Algeria negotiated by the French government is higher than the price it will pay at the German-Czechoslovakian border for Soviet gas.

On July 1, Trunkline LNG Co. and Panhandle Eastern PipeLine Co. filed arbitration documents with the International Chamber of Commerce as provided in the contract with SONATRACH to resolve controversies. The Trunkline-Panhandle position was that they knew of no technical reasons why LNG deliveries should not be initiated. The facility at Arzew was exporting LNG to Gaz de France's terminal at Montoir. They stated that total Algerian operable liquefaction capacity is 31.1 billion m^3/yr to cover sales commitments of 21.8 billion m^3/yr. The LNG tankers required to lift the cargoes were available; these are the tankers dedicated to the trade. The receiving terminal was ready to receive a cargo for cooldown.

SONATRACH had cited technical reasons for the delay in initiating deliveries at previous meetings with Trunkline-Panhandle.

At a scheduled meeting on Aug. 6, the parties agreed upon an amendment to the pricing provisions of the 1975 gas purchase contract. A shipping schedule was worked out that called for the first carrier to load at Arzew on Sept. 11. Full contract deliveries of six cargoes are scheduled for December. If achieved, this would trigger provisions of the contract under which Trunkline-Panhandle would file the amendment with U.S. regulatory authorities: DOE's Economic Regulatory Administration and the Federal Energy Regulatory Commission.

Until filed, provisions of the amendment stipulate that its provisions are to be released only to the extent required by law in both countries. From information that has been released, provisions include a new base price as of July 1, 1982, of $3.92/MMBtu. That price is to escalate/deescalate directly with changes in the average of the official posted export prices of five crude oils. Terms of the current contract (1975) remain in effect until approved by authorities having jurisdiction in Algeria and the U.S.

Although no interruptions in deliveries had occurred, Distrigas Corp. and SONATRACH announced that they had reached agreement on a new contract on Aug. 2. On Aug. 28, Distrigas filed applications with ERA and FERC that included a copy of the new agreement. Principal provisions were cited as:

1. An increase in the FOB price to $4.44/MMBtu;
2. A quarterly adjustment of the FOB price based upon average of six different crude oils;

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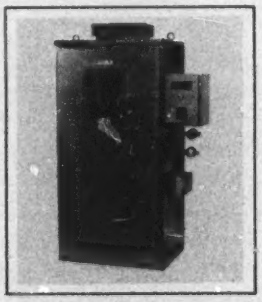

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3. A reduction in the take-or-pay obligation of Distrigas to SONATRACH[1] so that now Distrigas will be obligated to accept annual deliveries from only 14 ships; and

4. A modification of the delivery schedule to provide that delivery of the LNG cargoes will more closely coincide with the requirements for LNG of DOMAC's customers. (Nine cargoes will be delivered in the winter and five cargoes in the summer.)

5. An option,[2] exercisable in the sole discretion of Distrigas, to receive up to three additional ships in any one contract year

6. A change in method of calculating the Btu content of the LNG sold by SONATRACH and a resulting price reduction of approximately 5¢/MMBtu

7. Establishment of provisions to minimize demurrage

8. Postponement of the next contract review by two years until January 1986

9. A surcharge designed to give effect to the new, FOB price from and after the date of filing of this application.

Simultaneous with the execution of the amendment, the parties executed one side letter dealing with claims for demurrage and deadfreight relating to the period prior to July 1, 1982, and a second side letter setting forth the calculation of the surcharge referred to in provision No. 9 above.

Under the amendment, the new formula used to calculate the FOB price is as follows:

$$P = P_1 + (B - Bo)$$

in which:

P = the FOB price of LNG in U.S. dollars/MMBtu calculated to the sixth decimal place, the first date of the first month of each quarter of the Gregorian Calendar, to be applied in the course of such quarter, hereafter referred to as the "Quarter of Application"

P_1 = the base price, equal on July 1, 1982, to U.S. dollars 4.44/MMBtu to be applied during the third quarter of 1982

B = the arithmetic average, during the quarter preceding the Quarter of Application of the average prices, expressed in U.S. dollars/MMBtu, of the crude oils whose characteristics are set forth hereafter.

For calculation of B, the average price of each crude oil listed below is to be the arithmetic average of the daily prices of such oil, expressed in U.S. dollars/MMBtu, during the quarter preceding the Quarter of Application.

Conversion of the prices of such crude oils expressed in U.S. dollars/bbl to prices expressed in U.S. dollars/MMBtu is made based on the gross heating values that follow:

Crude Oils	Gravity, °API	Gross Heating Value, 10^6 Btu/bbl
Arabian Light (Saudi Arabia)	34	5.84
Sahara Blend (Algeria)	44	5.60
Bonny Light (Nigeria)	37	5.77
Isthmus (Mexico)	32	5.89
Minas (Indonesia)	34	5.84
Tia Juana (Venezuela)	26	6.03

The prices are to be official prices exclusive of rebates, premiums, or surcharges. Prices are to be those published by Platt's Oilgram Price Report (New York Edition). The price in effect is to be weighted by the number of days during which it has been in effect.

Bo = The value of B in the third quarter of 1982, that is, U.S. $5.879572/MMBtu, resulting from the calculation shown in the table:

[1]*The present take-or-pay obligation of Distrigas is 17 cargoes.*
[2]*This option permits Distrigas one additional ship to any quarter. From and after 1986, its option is reduced to two ships annually.*

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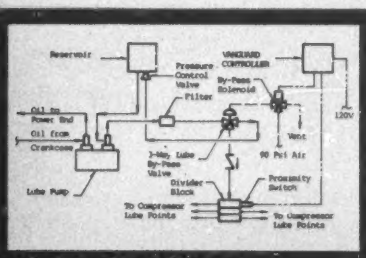

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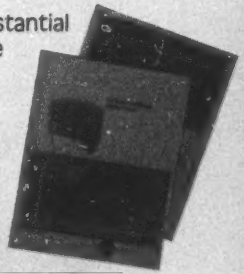

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Crude Oils	Price 2nd Quarter 1982 $/bbl	$/10⁶ BTU
Arabian Light (Saudi Arabia)	34.00	5.821918
Sahara Blend	35.50	6.339286
Bonny Light (Nigeria)	35.50	6.152513
Isthmus (Mexico)	32.50	5.517827
Minas (Indonesia)	35.00	5.993151
Tia Juana (Venezuela)	32.88	5.452736
Arithmetic Average		5.879572

On May 7, Phillips Petroleum Co. and Marathon Oil Co. filed an application seeking an ERA Order to approve continued exportation of 50.57 trillion Btu (approximately 135 MMcfd) of Alaskan LNG annually to Japan in the period between 1984 to 1989. Export would be carried out under an Amendatory Extension Agreement (dated April 15, 1982) to the 1967 Basic Agreement with Tokyo Gas Co., Ltd., and the Tokyo Electric Power Co., Inc.

Specifically, the Amendatory Agreement includes a provision that extends the term of the Basic Agreement (March 6, 1967) for a period of five years from June 1, 1984, to May 31, 1989. It further establishes a mechanism whereby authorized quantities of LNG, which are not delivered in any of the five years of the contract extension, are to be delivered in subsequent contract years or during a maximum seven-month makeup period beginning June 1, 1989.

In addition to approval of the contract extension, Phillips and Marathon also requested that ERA authorize makeup for the under-deliverics of LNG that have occurred during the 15-year term of the Basic Agreement. Total makeup volume as of May 31, 1982, is estimated at 3.2% of the cumulative contract quantity to that date. The applicants state that no additions to or alterations of the existing facilities, including two LNG tankers, are required for or contemplated during the 5-year extension period.

Pricing provisions covering the five-year extension period are contained in the 13th Amendatory Agreement dated April 15, 1982. Pricing provisions under Article 9 call for a c.i.f. base price of 592.8 U.S. cents/MMBtu as indexed to reflect changes in the weighted average of government selling prices of a basket of 20 crude oils imported into Japan. The specific formula and provisions include:

$$\text{Price for calendar month} = 592.8 \left[\frac{\text{Av. GSP (Month Prior to Calendar Month)}}{34.48}\right]$$

where:

Av. GSP is the average of the government selling prices (in U.S. dollars per barrel) weighted by the 1981 volumes for the top 20 crude oils (ranked by descending volumes) imported into Japan during the calendar year of 1981.

Sellers and buyers shall be free to request a renegotiation of the price if there are significant changes.

The Algeria-United Kingdom project has only received one spot cargo of Algerian LNG since the interim agreement to extend the project expired in June 1981. That cargo, lifted in February 1982, was used to keep the four cryogenic in-ground storage pits cold until procedures were implemented to decommission them. Filling of the four 300,000-bbl capacity containers was completed in July. The Canvey Island terminal facility will be maintained for peakshaving purposes using its 10.3 MMcfd liquefier to produce LNG from North Sea gas. The LNG would be stored in the 392,000 bbl of capacity available in the six small, conventional tanks. A project has also been completed to use 3000 tons of LPG storage capacity at the facility to supply LPG-air for peakshaving in the regional transmission system. **P&GJ**

NEXT MONTH: Part two discusses LNG projects under construction around the world, and discusses in detail 10 major "possible projects."

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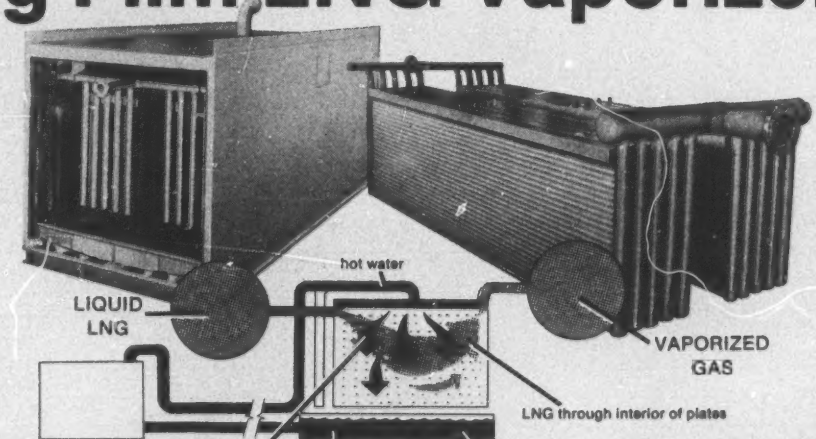

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